IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Taner, M. et al.	Art Unit :	2863
Serial No.:	10/035,955	Examiner :	Le, T.
		Docket No.:	RSI-003
Filed :	12/24/2001		
Title :	SYSTEM FOR UTILIZING SEISMIC DATA TO ESTIMATE SUBSURFACE LITHOLOGY		

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

APPELLANT'S BRIEF UNDER 37 CFR § 1.192

Sir:

This is an Appellant's Brief pursuant to 37 C.F.R. § 1.192 in the referenced application currently before the Board of Patent Appeals and Interferences.

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I. Real Party in Interest

The real party interest in the referenced application is RDSP I, L.P, a Texas limited partnership. RDSP I, L.P. obtained its interest in the present application by assignment of the inventors M. Turhan Taner and Matthew B. Carr dated February 26, 2002 and recorded at Reel 012690, Frame 0417 of the Assignment Records of the U.S. Patent and Trademark Office.

II. Related Appeals and Interferences

To the best of the knowledge of the Appellant and the Appellant's legal representative, there are no other appeals or interferences that will directly affect, be affected by, or have a bearing on the decision of the Board of Patent Appeals and Interferences (the Board) in the pending appeal.

III. Status of the Claims

Claims 1-12 were presented in the application as originally filed. All of claims 1-12 in their original form are still of record in the application. Claims 1-12 stand rejected as anticipated under 35 U.S.C. § 102(a) by Pennington, W., *Calibration of Seismic Attributes for Reservoir Characterization,* Annual Report, DOE Award No. DE-AC26-98BC15135 (Pennington). Claims 1-12 were originally rejected as anticipated by Pennington in an Office Action dated July 1, 2004. Appellant timely filed a response to that Office Action on August 16, 2004. In a subsequent Office Action dated September 10, 2004, the claims were again rejected as anticipated by Pennington, the assertion being that the declaration and evidence in support thereof were insufficient to establish conception of the claimed invention prior to publication on Pennington. The Appellant duly filed a request for continued examination on December 20, 2004, with the second declaration and evidence in support thereof. The Board has authority to hear this appeal because the claims have been twice rejected on the same basis.

IV. Status of Amendments

There are no amendments in the application.

V. Summary of the Appellant's Invention

Generally, the Appellant's invention is a method of geophysical exploration of a subsurface region of interest. The method includes using an unsupervised learning network to organize seismic data representing a subsurface region of interest. A portion of the organized seismic data is correlated with lithological data from a well bore located in the subsurface region of interest. The correlation is applied to the seismic data to estimate lithology in the subsurface region of interest.

VI. Issues

The issue before the Board is whether declarations of M. Turhan Taner filed in this application are sufficient to establish conception of the invention of claims 1-12 prior to publication of Pennington, W., *Calibration of Seismic Attributes for Reservoir Characterization,* Annual Report, DOE Award No. DE-AC26-98BC15135 (Pennington). Appellant respectfully requests that the Board reconsider the Examiner's finding that the declarations to not establish conception of the claimed invention prior to publication of Pennington.

VII. Grouping of Claims

Claims 1-12 stand or fall together.

VIII. Argument

In the Office Action of January 13, 2005, the Examiner stated that declarations filed under 37 CFR 1.131 on August 16, 2004 and on December 20, 2004 were insufficient to overcome rejections of claims 1-12 under 35 U.S.C. § 102(a). The reason for the insufficiency as stated in that Office Action was because the showing of the combined declarations was not consistent in scope with the claims in the application. *Office Action 1/13/2005*, p. 2. In particular, the claims in the present application, which recite "correlation" of organized seismic data with lithological data and the use of the correlation to estimate lithology, are thus asserted by the Examiner to be different in scope from what was shown to have been conceived (and reduced to practice) in the declarations and supporting evidence. The Examiner based his

assertion on that the process shown to have been conceived in the declarations includes selected portions of the seismic data are "calibrated" (as contrasted with being "correlated") with respect to lithological data, and the calibrated seismic data are used to estimate lithology in the subsurface region of interest from seismic data.

The Examiner did not dispute that a listing of computer code, along with a copy of an internal presentation concerning the invention as submitted with the declarations, showed all the other elements of claim 1 in combination, including estimating lithology from seismic data. Further, the Examiner did not dispute that what was declared to have been invented was fairly supported by the Exhibits submitted with the declarations. The Appellant believes that differentiating the inventive concept shown in the declarations, from what is literally recited in the claims, is a strained construction of what was shown to have been conceived, and is an equally strained construction of what is claimed in the present application. Appellant does not dispute that the words "calibrate" and "correlate" do have literally different meanings, however calibration is clearly one type of correlation, literally determining a relationship between a measurement or set of measurements and a standard for such measurements. In the context of the present invention, calibration is understood to mean determining a relationship between various attributes of seismic data and attributes of lithological data measured from a well bore, such that the seismic data may be used to infer or estimate lithology in a subsurface region of interest at locations other than at the location of the well bore. All of the foregoing organizing seismic data, calibration of the organized seismic data with respect to lithology and using the calibrated seismic data to estimate lithology, were shown by the declarations and exhibits thereto to have been conceived prior to publication of Pennington. Appellant respectfully directs the Board's attention to slide 10 of the exhibited presentation, in particular, in which the inventor himself describes "calibration" in the context of this invention as, "[c]alibration establishes a direct relation between classes and physical, lithological and reservoir related measurements." Clearly, the inventor himself understood that the process he developed included determining a relationship between classes (the classes developed by organizing seismic data) and the physical, etc. data. Thus, the inventor's own understanding of his process includes a step that fairly falls within the literal definition of "correlate" as understood by the Examiner.

Appellant respectfully notes that the Declarant in both declarations under 37 CFR §1.131, Dr. M. Turhan Taner, was making statements that were literally consistent with the precise language used in his internal reporting and presentation of the invention, namely "[a]t about the same time the lithology calibration technique was developed by me, I also used such lithology-calibrated Kohonen self-organized maps to infer reservoir properties from seismic data. A presentation of such application was made to colleagues from my employer during January 2001. A copy of slides from the presentation, clearly showing lithology-calibrated seismic data used to infer reservoir properties from such seismic data,..." [emphasis added]. Appellant notes, however, that the present application and claims were drafted by a skilled patent practitioner, while the internal reporting used to show evidence of the date of conception of the invention and its reduction to practice were drafted by the inventors. The inventor may have not selected the most appropriate wording to describe in his reports the invented method, nonetheless, the Appellant respectfully notes that the very act of using lithology-calibrated Kohonen organized seismic data in order to infer lithology from other portions of the seismic data necessarily includes "establishing or determining a relationship" between the Kohonen organized seismic data and lithology, or such could not be used to make inference about lithology. The Examiner cited one dictionary definition of "correlate", which on its face did not appear to include within its scope the meaning fairly implied by the Appellant's "calibration", see *Office Action 1/13/2005,* p. 3, but the Examiner did not cite another definition, which is "to present or set forth so as to show the relationship." *Merriam Webster Online Dictionary 11/30/2004*, supplied as an exhibit to the Second Declaration of M. Turhan Taner. Clearly, for the process described in the Declarant's exhibits to perform the stated function it is essential that the organized seismic data be processed in a way such that a relationship between the lithology and the organized seismic data is in fact established. The inventors' choice of terminology does not change this fact.

In the Office Action of January 13, 2005, the Examiner stated that because the declarations did not show conception of correlating seismic data to lithological data, that "objective evidence of non-obviousness is [not] commensurate in scope with the claims." *Office Action 1/13/05*, p. 2. Appellant fails to see the relevance of that statement. The Examiner rejected the Appellant's claims as being anticipated by Pennington. Appellant produced declarations and evidence in support of the declarations tending to show that the inventor had

conceived of at least one implementation of the claimed invention prior to publication of the Pennington reference. No showing of non-obviousness is at issue in the present appeal.

The Examiner also stated in the Office Action of January 13, 2005 that "the Pennington et al. annual report started on 10/1/00 comparing to the Second Declaration of M. Turhan Taner, showing source code, established that not later than January 2001, as claimed by Applicant shown in Exhibit A…." *Office Action 1/13/05*, p. 3. Appellant respectfully notes that a purported starting date of a reporting period for a non-patent publication has no bearing on the applicability of that publication as prior art under 35 U.S.C. § 102(a). The Pennington et al. reference is effective as prior art under the portion of 35 U.S.C. § 102(a) "described in a printed publication" as of the date the publication was available to an interested member of the public. For purposes of the present application, the Pennington publication has a date of October 2001. Appellant has clearly been able to show priority with respect to Pennington as a publication. Appellant respectfully notes that M.P.E.P. 2131, I. states that "known or used in this country" as recited in 35 U.S.C. § 102(a) means knowledge or use <u>which is accessible to the public</u>. See M.P.E.P. 2131 I., p. 2100-73, Original 8th Edition, August 2001. The knowledge conveyed by Pennington was accessible to the public only on the date of publication, which is believed to be not earlier than October 1, 2001. Therefore, any purported starting date for activities reported in Pennington has no relevance to the effective date of Pennington as prior art to the Appellant's claimed invention.

IX. Conclusion

The Appellant has shown that conception of the claimed invention took place prior to publication of Pennington, and therefore Appellant's claims are not anticipated by Pennington. The Appellant respectfully requests that the Board reverse the finding of the Examiner that the claims in the application are anticipated by Pennington, and that the application be allowed.

Respectfully submitted,

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Date: 14 Feb. 2005

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APPENDIX A

Claims Of Record In The Application

[c1] A method of geophysical exploration of a subsurface region of interest, comprising:
utilizing an unsupervised learning network to organize seismic data representing a subsurface region of interest;
correlating a portion of said organized seismic data with lithological data from a well bore located in said subsurface region of interest; and
applying said correlation to said seismic data to estimate lithology in said subsurface region of interest.

[c2] The method of claim 1 wherein said unsupervised learning network is a self organizing feature map.

[c3] The method of claim 1 wherein said unsupervised learning network is a Kohonen network.

[c4] A method of geophysical exploration of a subsurface region of interest, comprising:
applying a plurality of seismic data attributes for measurement location from a seismic data set from a subsurface region of interest to a Kohonen network to organize said seismic data set into a plurality of seismic Kohonen classes;
selecting a subset of said organized seismic data representative of the earth's subsurface in the vicinity of a well bore penetrating said subsurface region of interest;
correlating Kohonen classes of said subset of said organized seismic data set with classes of lithological data from said well bore to generate a correlation between Kohonen classes and lithological classes; and
applying said correlation to said seismic data set to estimate lithology of said measurement locations.

[c5] The method of claim 4 wherein said seismic data attributes comprise semblance, amplitude-versus-offset and attenuation.

[c6] The method of claim 4 wherein said lithological data comprises volume shale and acoustic impedance.

[c7] A method of geophysical exploration of a subsurface region of interest, comprising:

applying a plurality of lithology values for measurement location from a well bore penetrating a subsurface region of interest to a Kohonen neural network to organize said lithology values into a plurality of lithology Kohonen classes;

utilizing said lithology Kohonen classes to establish ranges of a lithology value;

applying a plurality of seismic data attributes for measurement location from a seismic data set from said subsurface region of interest to a Kohonen network to organize said seismic data set into a plurality of seismic Kohonen classes;

selecting a subset of said organized seismic data set representative of the earth's subsurface in the vicinity of said well bore penetrating said subsurface region of interest;

correlating Kohonen classes of said subset of said organized seismic data set with classes of lithological data from said well bore to generate a correlation between Kohonen classes and lithological classes, wherein said ranges of a lithology value are utilized in establishing boundaries of said lithology classes; and

applying said correlation to said seismic data set to estimate lithology of said measurement locations from said subsurface region of interest.

[c8] The method of claim 7 wherein said lithology values are volume shale and acoustic impedance.

[c9] The method of claim 7 wherein said seismic data attributes comprise semblance, amplitude-versus-offset and attenuation.

[c10] A device which is readable by a digital computer having instructions defining the following process and instructions to the computer to perform said process:

utilizing an unsupervised learning network to organize seismic data representing a subsurface region of interest;

correlating a portion of said organized seismic data with lithological data from a well bore located in said subsurface region of interest; and

applying said correlation to said seismic data to estimate lithology in said subsurface region of interest.

[c11] A device which is readable by a digital computer having instructions defining the following process and instructions to the computer to perform said process:

applying a plurality of seismic data attributes for measurement location from a seismic data set from a subsurface region of interest to a Kohonen network to organize said seismic data set into a plurality of seismic Kohonen classes;

selecting a subset of said organized seismic data representative of the earth's subsurface in the vicinity of a well bore penetrating said subsurface region of interest;

correlating Kohonen classes of said subset of said organized seismic data set with classes of lithological data from said well bore to generate a correlation between Kohonen classes and lithological classes; and

applying said correlation to said seismic data set to estimate lithology of said measurement locations.

[c12] A device which is readable by a digital computer having instructions defining the following process and instructions to the computer to perform said process:

applying a plurality of lithology values for measurement location from a well bore penetrating a subsurface region of interest to a Kohonen neural network to organize said lithology values into a plurality of lithology Kohonen classes;

utilizing said lithology Kohonen classes to establish ranges of a lithology value;

applying a plurality of seismic data attributes for measurement location from a seismic data set from said subsurface region of interest to a Kohonen network to organize said seismic data set into a plurality of seismic Kohonen classes;

selecting a subset of said organized seismic data set representative of the earth's subsurface in the vicinity of said well bore penetrating said subsurface region of interest;

correlating Kohonen classes of said subset of said organized seismic data set with classes of lithological data from said well bore to generate a correlation between Kohonen classes and lithological classes, wherein said ranges of a lithology value are utilized in establishing boundaries of said lithology classes; and

applying said correlation to said seismic data set to estimate lithology of said measurement locations from said subsurface region of interest.

APPENDIX B

DECLARATIONS AND EXHIBITS

REMARKS

Claim Rejections – 35 U.S.C. § 102(a)

In the Office Action dated September 10, 2004, claims 1-12 stand finally rejected as anticipated by, Pennington, W., *Calibration of Seismic Attributes for Reservoir Characterization,* Annual Report, DOE Award No. DE-AC26-98BC15135 (Pennington).

The Applicant respectfully submits herewith a Second Declaration of M. Turhan Taner which establishes conception of the claimed invention and reduction to practice prior to the effective date of Pennington as prior art under 35 U.S.C. § 102(a). The Applicant does not, by submitting the Declaration, admit that the disclosure of Pennington is within the scope of the Applicant's claims.

In the Office Action dated September 10, 2004, it was stated that a previously filed Declaration of M. Turhan Taner was not sufficient proof of conception of the claimed invention, more specifically, that the Declaration was not "relevant" to the claims. The Applicant's Second Declaration is intended to be responsive to that specific issue.

In particular, claim 1 recites a method of geophysical exploration including:

> a) organizing seismic data using an unsupervised learning network;
> b) correlating a portion of the organized seismic data with lithological data from a wellbore located in a subsurface region of interest, and
> c) applying the correlation to the seismic data to estimate lithology in the subsurface region of interest.

Clearly, the first Declaration establishes that the Applicant conceived of organizing seismic data using an unsupervised learning network. The Kohonen self-organizing map technique is one embodiment of such organization. In the Office Action of September 10, 2004, it was stated that the claimed "correlating" the organized seismic data to lithology was not proven as conceived by the Declaration. The Second Declaration is intended to be responsive to this point, to the extent the first Declaration does not already make such proof. The Declarant (Applicant) clearly has shown conception and reduction to practice of calibration of organized seismic data to lithology. Applicant respectfully points out that "calibration" is in fact one form

of "correlation", specifically, correlating a measurement to a standard. As evidence of the foregoing statement, Applicant respectfully submits herewith definitions from *Merriam-Webster Online* definitions of "calibrate", meaning among other things, "to adjust precisely for a particular function" and "correlate", meaning among other things "to present or set forth as to show the relationship." Clearly, a person of ordinary skill in the art, having the benefit of the Applicant's disclosure, would understand that "calibration" as stated in the Declarations and in the Applicant's specification supporting documentation fully enables "correlation" of lithology from wellbore data to organized seismic data as recited in Applicant's claim 1.

Thus, the Second Declaration of M. Turhan Taner establishes that not later than January 2001, source code had been written, and described to colleagues of the Applicant which performed the steps of: organizing seismic data using an unsupervised learning network; calibrating the organized seismic data using lithology data from wellbores, and using the calibrated seismic data to infer lithology.

The Applicant believes that this Reply is fully responsive to the ground of rejection stated in the Office Action of September 10, 2004, and respectfully requests early favorable action on this application.

Respectfully submitted,

Date: 12/12/2003

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SECOND DECLARATION OF M. TURHAN TANER

M. Turhan Taner declares that:

I am currently employed by and have been employed by RDSP I, LP, the assignee of all right, title and interest in the referenced patent application since 1994 as a research geophysicist. I have published numerous papers on the subject of seismic attributes and their application to interpretation of seismic data. I am the same person who authored a publication cited in an Office Action dated November 6, 2003 in the referenced patent application entitled, *Kohonen's Self-Organizing Networks With "Conscience"*, Seismic Research Corporation. I have worked on various research projects related to Kohonen self-organizing maps since at least the time of publication of the foregoing publication.

During late 1999, and in the regular course of my employment with RDSP I, LP, I conceived of a way to calibrate self organizing map clusters for use in reservoir characterization. I worked on a number of experimental computer programs intended to embody the concept. A result of my development work is memorialized in a report for internal review at RDSP I, LP entitled, *Calibration of Self-Organizing Maps*, produced in November 2000. A copy of that report was previously submitted for consideration by the Patent and Trademark Office in a Reply filed to the Office Action of July 1, 2004. The report expressly explains a calibration method for providing a relationship between each self organized map and wellbore-measured lithology.

Experimental computer source code intended to embody the calibration method described in the above report was generated as early as February 2000, and was revised to improve its performance in January 2001. A copy of relevant portions of the source code showing the various calibration routines is attached as Exhibit A.

At about the same time the lithology calibration technique was developed by me, I also used such lithology-calibrated Kohonen self-organized maps to infer reservoir properties from seismic data. A presentation of such application was made to colleagues from my employer during January 2001. A copy of slides from the presentation, clearly showing lithology-calibrated seismic data used to infer reservoir properties from such seismic data, is attached as Exhibit B. The slides relating to "reservoir characterization" shown in the presentation in Exhibit B are graphic displays of a number of properties of a subsurface reservoir, including mineral composition of the reservoir rock, which is referred to as "lithology"; fractional volume of pore space in the rock, referred to as "porosity", and fluid content of the rock in terms of hydrocarbon and water fractional volumes filling the pore space.

All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. Further, these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

M. Turhan Taner

M. Turhan Taner

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C***********************************************************************
      SUBROUTINE  RBF_CALIB(CLAS, ATRIB, NOATR, NDTA, NCLAS,
     *                      SOFM, NOXX, NOYY, MAPS,HDOUT,
     *                      NOSOM,GAUS,WEG,CLANO, TEM,DOUT,CLASSX,
     *                      ISTAT)
C
C***********************************************************************
**
C
      IMPLICIT NONE
      SAVE
C
C+RBF_CALIB
C
C-FUNCTION:   THIS SUBROUTINE CALIBRATES THE UNSUPERVISED CLUSTERING
C                    BASED ON GIVEN CLAS BORE MEASUREMENTS
C                   BY RADIAL BASIS FUNCTION NETWORK LOGIC
C
C-CALLING SEQUENCE:
C
C           CALL RBF_CALIB(CLAS,SOFM,NDTA,NOXX,NOYY ....)
C
C-ARGUMENTS:
C
C  CLAS(*)  = WELL BORE LITHOLOGY OR RESERVOIR CLASSIFICATION NUMBER
C  ATRIB(*) = ATTRIBUTES CORRESPONDING EACH WELL BORE SAMPLES
C  NOATR    = NUMBER OF ATTRIBUTE  SAME NUMBER AS SOM COEFFICIENTS)
C  NDTA     = NUMBER OF WELL BORE SAMPLES
C  NCLAS    = TOTAL NUMBER OF WELL BORE CLASSES
C  SOFM(*)  = SELF ORGANIZING FEATURE MAP CLUSTER COEFFICIENTS
C             WELL BORE CLASSIFICATION NUMBER.
C  NOXX     = NUMBER OF NEURONS IN X DIRECTION.
C  NOYY     = NUMBER OF NEURONS IN Y DIRECTION
C  MAPS     = KOHONEN MAP TYPE. ( 1 = ONE D, 2 = RECTANGULAR, 3
=TRIANGULAR)
C
C--- TEM(*) = TEMPORARY STORAGE AREA  , IT SHOULD BE AT LEAST 6*NOSOM
LING
C
C----- OUTPUT ---------
C
C  HDOUT(I) = HIDDEN LAYER OUTPUT FROM EACH NEURON FOR ALL THE TRAINING
DATA
C             SAMPLES. ARRAY WILL BE NOXX8NOYY*NDTA SAMPLES LONG.
C  NOSOM    = TOTAL NUMBER OF SOM NEURONS,
C  GAUS(*)  = SHAPING FACTORS OF SOM NEURONS GAUSSIAN SHAPE RADIAL
FUNCTION
C  WEG(*)   = OUTPUT LAYER WEIGHTS FOR EACH OUTPUT NEURON ( EACH NOSOM
ELEMENTS)
C  CLANO(*) = USER ASSIGNED CLASS NUMBER FOR EACH OUTPUT NEURON (NCLAS
LONG)
C  DOUT(*)  = DESIRED OUTPUT ARRAY (NDTA)
C
C-DESCRIPTION:
C
C    BIG LOOP IS ON EACH LITHOLOGY CLASS;(OPTIMIZED SEPARATELY)
C    IN THE FIRST PASS WE WILL ESTABLISH AVERAGE DISTANCES TO EACH SOM
C    NEURON. THIS WILL CONTROL( GAUSSIAN ) RADIAL BASIS FUNCTION SHAPE.
C    FOR EACH LITHOLOGY CLASS, THE EUCLIDEAN DISTANCE WILL BE COMPUTED
C    BETWEEN EACH TRAINING DATA SAMPLE ( CONSISTING OF ATTRIBUTES PICKED
C    FROM THE VICINITY OF WELLS) AND EACH NEURON. THIS WILL BE INPUT TO
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C     THE RADIAL BASIS FUNCTIONS OF THE NEURON, WHICH WILL PRODUCE THE
C     OUTPUT OF THE HIDDEN LAYER. THESE OUTPUTS WILL BE THE INPUT TO THE
C     OUTPUT LAYER NEURONS.
C     WEIGHTS OF THE OUTPUT LAYER NEURONS WILL BE COMPUTED ONE CLASS AT A
C     TIME BY THE WIENER FILTER LMS METHOD.
C     COMPUTATION WILL BE REPEATED FOR EACH INDIVIDUAL LITHOLOGY CLASS.
C
C-REVISED:  27-FEBRUARY-2000     BY    M. TURHAN TANER
C-REVISED:  16-FEBRUARY-2001     BY    M. TURHAN TANER , DAVID DUMAS
C-REVISED:   1-AUGUST   -2001     BY    M. TURHAN TANER , DAVID DUMAS
C
C
C++
C
      INTEGER*4    NOXX,NOYY, MAPS, NDTA,NCLAS, MITER, NITER
      INTEGER*4    I, IS, IP,IK, NOSOM,ICL,NOATR,J,K,ICO,IPC
      INTEGER*4    IK1,IK2,IK3,IK4,IK5,IW
      INTEGER*4    IT,LAST,STATUS,ISTAT

      REAL*4       CLAS(1:*), PCLAS(200),HDOUT(1:*),GAUS(1:*)
      REAL*4       SOFM(1:*), ATRIB(1:*),DISAV,DIST,WEG(1:*)
      REAL*4       AA,CLANO(1:*),AMIN,RRAT,DOUT(1:*)
      REAL*4       CLASSX(1:*)
      REAL*4       TEM(1:*)
C
C------ INITIALIZE COMPUTATION CONSTANTS
C
          NOSOM = NOXX
        IF(MAPS .EQ. 2 )  NOSOM = NOXX*NOYY
        IF(MAPS .EQ. 3 )  NOSOM = NOXX*(NOXX+1)/2
        IK1 = 1
        IK2 = IK1 + NOSOM
        IK3 = IK2 + NOSOM
        IK4 = IK3 + NOSOM
        IK5 = IK4 + NOSOM
        NITER = 20
        MITER = 10
        RRAT  = 0.00001
        LAST  = (NOSOM+1)*10
C
C++++++++++ CALCULATE AVERAGE EUCLIDEAN DISTANCE BETWEEN CALIBRATION
C                     DATA AND  SOM NEURONS
C
        DO    I = 1, NOSOM
            GAUS(I)  = 0.
            PCLAS(I) = 0.
        ENDDO
            DISAV = 0.0
        DO   300        ICL = 1, NDTA
            DIST = 99999999.
            ICO  = 0
            IPC  = (ICL-1)*NOATR
          DO         I = 1, NOSOM
            IS = (I-1)*NOATR
            AA = 0.0
            DO   J =1, NOATR
              AA = AA+(ATRIB(IPC+J)-SOFM(IS+J))**2
            ENDDO
              IF( AA .LT. DIST ) THEN
                  DIST = AA
                   ICO = I
```

```
C***********************************************************************
*
        SUBROUTINE  CALERR( IWELL, ATRIB, NOATR, NWELL, NOCLASS,
     *                      SOFM, NOXX, NOYY, MAPS,
     *                      CALIB, PCLAS, CERR,CPROB,NOERR,
     *                      TOTAL,CLASS)
C
C***********************************************************************
**
C
      IMPLICIT NONE
      SAVE
C
C+CALERR
C
C-FUNCTION:   THIS SUBROUTINE COMPUTES CALIBRATION ERROR OF SOM
C                    BASED ON GIVEN WELL BORE MEASUREMENTS
C                    BY GENERATING MAXIMUM PROBABILITY
C
C-CALLING SEQUENCE:
C
C           CALL CALERR(IWELL,ATRIB,NOATR,NWELL,....)
C
C-ARGUMENTS:
C
C  IWELL(*) = WELL BORE LITHOLOGY OR RESERVOIR CLASSIFICATION NUMBER
C  ATRIB(*) = ATTRIBUTES CORRESPONDING EACH WELL BORE SAMPLES
C  NOATR    = NUMBER OF ATTRIBUTE  SAME NUMBER AS SOM COEFFICIENTS)
C  NWELL    = NUMBER OF WELL BORE SAMPLES
C  NOCLASS  - TOTAL NUMBER OF WELL BORE CLASSES
C  SOFM(*)  = SELF ORGANIZING FEATURE MAP CLUSTER COEFFICIENTS
C             WELL BORE CLASSIFICATION NUMBER.
C  NOXX     = NUMBER OF NEURONS IN X DIRECTION.
C  NOYY     = NUMBER OF NEURONS IN Y DIRECTION
C  MAPS     = KOHONEN MAP TYPE. ( 1 = ONE D, 2 = RECTANGULAR, 3
=TRIANGULAR)
C  CALIB(*) = WELL BORE LITHOLOGY CLASSES OF EACH INPUT SOM NEURON
C  CLASS(*) = CLASSIFICATION FROM SELFORG FOR UNDEFINE VALUES
C
C----- OUTPUT ---------
C
C             NOTE: OUTPUT ARRAYS WILL BE "NWELL" LONG AND THEY WILL
C             CORRESPOND TO EACH TRAINING DATA SAMPLK.
C
C  PCLAS(*) = PREDICTED CLASS ACCORDING TO THE CALIBRATION
C  CERR(*)  = ERROR OF CLASSIFICATION ( DIFFERENCE BETWEEN PREDICTED AND
C             ACTUAL CLASSES
C  CPROB(*) = EUCLIDEAN DISTANCE BETWEEN NEAREST NEURAN AND THE DATA
C  NOERR(*) = TOTAL NUMBER OF ERRONEOUS CLASSIFICATIONS OF EACH SOM
NODE.
C  TOTAL(*) = TOTAL PICKS AT A NODE
C
C-DESCRIPTION:
C
C    BIG LOOP IS ON EACH LITHOLOGY CLASS;
C    FOR EACH LITHOLOGY CLASS, EACH DATA SAMPLE ( CONSISTING OF
ATTRIBUTES
C    PICKED FROM THE VICINITY OF WELLS) VECTOR DOT PRODUCT WILL BE
COMPUTED.
C    WITH EACH NEURON. THE INPUT DATA WILL BE CLASSIFIED BELONGING TO
THE
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```
C    SAME CLASS OF THE CALIBRATED NEURON.
C
C-REVISED:  20-FEBRUARY-2000     BY    M. TURHAN TANER
C-REVISED:  16-JANUARY -2001     BY    M. TURHAN TANER , DAVID DUMAS
C
C
C++
C
      INTEGER*4    NOXX,NOYY, MAPS, NWELL,NOCLASS, NOERR(1:*)
      INTEGER*4    I, IS, NOSOM,ICL,NOATR,J,ICLAS,TOTAL(1:*)

      REAL*4       IWELL(1:*), PCLAS(1:*), CALIB(1:*),CPROB(1:*)
      REAL*4       SOFM(1:*), IPC,ATRIB(1:*),DIST
      REAL*4       AA, CERR(1:*),CLASS(1:*),LAST
C
C------ INITIALIZE COMPUTATION CONSTANTS
C
           NOSOM = NOXX
        IF(MAPS .EQ. 2 )  NOSOM = NOXX*NOYY
        IF(MAPS .EQ. 3 )  NOSOM = NOXX*(NOXX+1)/2
        LAST = (NOSOM+1)*10
C
C++++++++++ CALCULATE ECLIDEAN DISTANCE BETWEEN CALIBRATION
C                 DATA AND  SOM NEURONS
C
        DO   I = 1, NOSOM
            NOERR(I) = 0
            TOTAL(I) = 0
        ENDDO
        DO   I = 1,NWELL
            CPROB(I) = 0.0
            PCLAS(I) = 0.0
            CERR(I)  = 0.0
        ENDDO
        DO   300        ICL = 1, NWELL
            DIST  = 99999999.
            ICLAS = 0
            IPC   = (ICL-1)*NOATR
          DO        I = 1, NOSOM
            IS = (I-1)*NOATR
            AA = 0.0
            DO   J =1, NOATR
              AA = AA+(ATRIB(IPC+J)-SOFM(IS+J))**2
            ENDDO
              IF( AA .LT. DIST ) THEN
                DIST = AA
                ICLAS= I
              ENDIF
          ENDDO
C
C------ CHECK IF CLASSIFICATION MATCHES THE CALIBRATED CLASS
C
         CPROB(ICL) = DIST
         PCLAS(ICL) = 0.
         IF(CLASS(ICLAS).LT.LAST.AND.CALIB(ICLAS).GT.0.0) THEN
             PCLAS(ICL) = CALIB(ICLAS)
         ENDIF
         IF(IWELL(ICL).GT.0..AND.CLASS(ICLAS).LT.LAST) THEN
             TOTAL(ICLAS) = TOTAL(ICLAS)+1
             CERR(ICL)   = IWELL(ICL) - PCLAS(ICL)
             IF( CERR(ICL) .NE. 0.0) NOERR(ICLAS) = NOERR(ICLAS) + 1
```

```
C***********************************************************************
        SUBROUTINE  CALPROB ( IWELL, ATRIB, NOATR, NWELL, NOCLASS,
     *                        SOFM, NOXX, NOYY, MAPS,
     *                        CALIB, PROB,SDISA,SCALE,NITR,PAVE,WEG,
     *                        CLASS )
C
C***********************************************************************
**
C
      IMPLICIT NONE
      SAVE
C
C+CALIBRT
C
C-FUNCTION:   THIS SUBROUTINE CALIBRATES THE UNSUPERVISED CLUSTERING
C                     BASED ON GIVEN WELL BORE MEASUREMENTS
C                     BY GENERATING MAXIMUM PROBABILITY
C
C-CALLING SEQUENCE:
C
C            CALL CALPROB(WELL,SOFM,NWELL,NOXX,NOYY ....)
C
C-ARGUMENTS:
C
C  IWELL(*)  = WELL BORE LITHOLOGY OR RESERVOIR CLASSIFICATION NUMBER
C  ATRIB(*)  = ATTRIBUTES CORRESPONDING EACH WELL BORE SAMPLES
C  NOATR     = NUMBER OF ATTRIBUTE  SAME NUMBER AS SOM COEFFICIENTS)
C  NWELL     = NUMBER OF WELL BORE SAMPLES
C  NOCLASS   - TOTAL NUMBER OF WELL BORE CLASSES
C  SOFM(*)   = SELF ORGANIZING FEATURE MAP CLUSTER COEFFICIENTS
C              WELL BORE CLASSIFICATION NUMBER.
C  NOXX      = NUMBER OF NEURONS IN X DIRECTION.
C  NOYY      = NUMBER OF NEURONS IN Y DIRECTION
C  MAPS      = KOHONEN MAP TYPE. ( 1 = ONE D, 2 = RECTANGULAR, 3
=TRIANGULAR)
C
C----- OUTPUT ---------
C
C  CALIB(I)  = WELL BORE LITHOLOGY CLASSES OF EACH INPUT SOM NEURON
C  PROB(I)   + PROBABILITY OF EACH CALIBRATION ( 0<PROB<100 )
C
C-DESCRIPTION:
C
C    BIG LOOP IS ON EACH LITHOLOGY CLASS;
C    FOR EACH LITHOLOGY CLASS, EACH DATA SAMPLE ( CONSISTING OF
ATTRIBUTES
C    PICKED FROM THE VICINITY OF WELLS) VECTOR DOT PRODUCT WILL BE
COMPUTED.
C    WITH EACH NEURON. THIS WILL BE THE PROBABILITY OF EACH DATA POINT.
C    THESE VALUES WILL BE ACCUMULATED FOR ALL DATA POINTS FOR THAT CLASS
AND
C    RESULTS WILL BE DIVIDED BY THE NUMBER OF POINTS. THIS WILL
CONSTITUTE
C    THE PROBABILITY OF THAT CLASS.
C    NEXT WE WILL USE BAYESIAN LOGIC, THAT IS COMPARE THIS PROBABILITY
FUNCTION
C    WITH THE STORED MAXIMUM PROBABILITY FUNCTION OF PREVIOUS
COMPUTATIONS.
C    FOR EACH NEURON, IF THE NEW ONE IS LESS THAN PREVIOUS ONE, THEN GO
TO THE
C    NEXT NEURON. IF GREATER , THEN UPDATE THE MAXIMUM PROBABILITY AND
```

```
SET THE
C    NEW CLASS NUMBER ON THE LIST FOR THAT NEURON.
C    REPEAT THIS FOR ALL THE CLASSES. AT THE END, WE WILL HAVE TWO
TABLE,
C    SIMILAR TO THE KOHONEN MAP; ONE CLASS ASSIGNMENT FOR EACH NEURON,
AND
C    THE SECOND ONE PROBABILITY OF THAT CLASS ASSIGNMENT. THESE TABLES
WILL
C    LATER BE USED FOR (CALIBRATED) CLASSIFICATION OF THE WHOLE DATA
VOLUME.
C
C-REVISED:  20-FEBRUARY-2000     BY   M. TURHAN TANER & NAUM DERZHI
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C
C
C++
C
      INTEGER*4    NOXX,NOYY, MAPS, NWELL,NOCLASS, ITER
      INTEGER*4    I, M, IS, NOSOM,ICL,NOATR,KATR,K
      INTEGER*4    NITR,ISO,J,IMM,NUMWELL

      REAL*4       IWELL(1:*), PCLAS(200,40), CALIB(1:*), PROB(1:*)
      REAL*4       SOFM(1:*), IPC,NXCL,ATRIB(1:*),WG,ALPA
      REAL*4       AA,BETA,APC, SDISA, PAVE(1:NOXX,1:NOCLASS)
      REAL*4       WEG(1:NOXX,1:NOCLASS),DISAV,DIST
      REAL*4       SCALE,CLASS(1:*),LAST,ADD,JCLASS(100)
C
C------ INITIALIZE COMPUTATION CONSTANTS
C
           NOSOM = NOXX
        IF(NITR.LT.1) NITR = 1
        IF(NITR.GT.4) NITR = 4
        LAST = (NOSOM+1)*10.
C
C++++++++++ CCALCULATE AVERAGE ECLIDEAN DISTANCE BETWEEN CALIBRATION
C                     DATA AND  SOM NEURONS
          DISAV = 0.0
          NUMWELL = 0
        DO   300         ICL = 1, NWELL
          IF(IWELL(ICL).LT.0.0) GOTO 300
          DIST = 99999999.
          IMM  = (ICL-1)*NOATR
         DO         I = 1, NOSOM
          IS = (I-1)*NOATR
          AA = 0.0
          DO   J =1, NOATR
            AA = AA+(ATRIB(IMM+J)-SOFM(IS+J))**2
          ENDDO
            IF( AA .LT. DIST ) DIST = AA
         ENDDO
          DISAV = DISAV + DIST
          NUMWELL = NUMWELL+1
300     CONTINUE
C
C-------- AVERAGE DISTANCE (SQUARE)
C
         DISAV = DISAV/NUMWELL
         DISAV = DISAV*SCALE*SCALE
         ALPA  = ALOG(0.5)/DISAV
         SDISA = SQRT(DISAV)
C
```

Calibration

- Calibration establishes a direct relation between classes and physical, lithologic and reservoir related measurements.
- Unsupervised classification has to follow a calibration session.
- Supervised trained networks classification is calibrated during the training.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant :	Taner, M. et al.	Art Unit :	2863
Serial No.:	10/035,955	Examiner :	Le, T.
		Docket No.:	RSI-003

Filed : 12/24/2001
Title : SYSTEM FOR UTILIZING SEISMIC DATA TO ESTIMATE SUBSURFACE LITHOLOGY

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

DECLARATION OF M. TURHAN TANER

M. Turhan Taner declares that:

I am currently employed by and have been employed by RDSP I, LP, the assignee of all right, title and interest in the referenced patent application since 1994 as a research geophysicist. I have published numerous papers on the subject of seismic attributes and their application to interpretation of seismic data. I am the same person who authored a publication cited in an Office Action dated November 6, 2003 in the referenced patent application entitled, *Kohonen's Self-Organizing Networks With "Conscience"*, Seismic Research Corporation. I have worked on various research projects related to Kohonen self-organizing maps since at least the time of publication of the foregoing publication.

During late 1999, and in the regular course of my employment with RDSP I, LP, I conceived of a way to calibrate self organizing map clusters for use in reservoir characterization. I worked on an number of experimental computer programs intended to embody the concept. A result of my development work is memorialized in a report for internal review at RDSP I, LP entitled, *Calibration of Self-Organizing Maps*, produced in November 2000. A copy of that report is attached as Exhibit A. The report expressly explains a calibration method for providing a relationship between each self organized map and wellbore-measured lithology.

Experimental computer source code intended to embody the calibration method described in the above report was generated as early as February 2000, and was revised to improve its performance in January 2001. A header comment table from the source code is attached as Exhibit B to show date of creation of the computer source code.

All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. Further, these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

M. Turhan Taner

M. Turhan Taner

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C
C
C++
C
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